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(54) **A METHOD OF CONTROLLING THE WORKING DISTANCE BETWEEN FIRST AND SECOND CYLINDRICAL SURFACES OF A STAPLE FIBRE TREATMENT MACHINE AND APPARATUS FOR CARRYING OUT THE METHOD.**

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A method of controlling the working distance between first and second cylindrical surfaces of a staple fibre treatment machine and apparatus for carrying out the method

The present invention relates to a method of controlling the working distance between first and second cylindrical surfaces of a staple fibre treatment machine each of which is equipped with a point clothing and at least one of which is a surface of a rotatable cylinder, with the first and second cylindrical surfaces cooperating to process and/or mutually transfer a fibre web. The invention also relates to apparatus for carrying out the method. In staple fibre spinning, particularly in the first stages of the process leading to the yarn formation, the problem arises of bringing progressive order into the random arrangement of fibres as it prevails in the bales and at the same time to eliminate the impurities contained in the raw material. This problem is solved using fibre processing machines of the type described above, in which the fibres in the form of a thin fibre web are transferred from a first cylinder equipped with a clothing to a second cylinder which is also equipped with a clothing, or in which the fibres of the fibre web are subject to a combing or carding process between the relatively moving surfaces of two cylinders, by the points of the clothing without transfer of fibres from one cylinder to the other. The transfer of the fibres between two cylinders as well as the carding action depend substantially on the working conditions between the two cylinders involved. The working distance between the cylindrical surfaces at the transfer point, or at the processing point exerts a decisive influence on the efficiency of the method and on the quality of the finished product (besides other factors, such as the type of clothing points and the surface speed). Experience has shown that the transfer of the fibres as well as the carding action is improved, if the working distance is made smaller. The working distance is thus made as narrow as possible, preferably of the order of 1/10 mm.

The term working distance will be understood to mean the distance or clearance at the closest point between the points of the clothings of the two surfaces.

In order to increase the production rate of the machines in question two basic approaches have been taken, namely, increasing the speed of the processing elements and increasing the dimensions of the cylindrical surfaces of the machine, i.e. the diameter as well as the working width. Such increases, however, imply compromises concerning the quality of the working conditions because both the increased rotational speed and the increased dimensions result in undesirable deformation of the cylindrical surfaces or cylinders e.g. bulging due to centrifugal force. A further effect directly connected with the increase of the production rate and thus of the carding action is the increased thermal expansion of the cylinders involved,

which is made worse by the present trend of suppressing to a large extent the air exchange between the cylinders and the surrounding room, in order to prevent dust emissions, which impedes the natural cooling of the working elements. The temperature of the cylinders involved thus increases over a period of operating until an equilibrium temperature is reached, which can reach values of about 30°C, with an associated change in the dimensions of the cylinders and in particular of their diameters.

The effects of centrifugal force, as well as the effects of the increase in temperature do not become noticeable immediately upon the start-up of the machine, but only after a certain time delay. So far as centrifugal force is concerned this time delay is, as a minimum, the acceleration period of the elements involved, and, in the case of the card, of the main cylinder. Experience has shown that the effects of the increase of temperature, extend over much longer periods of time, until an equilibrium temperature is established, which can take several hours.

Using known machines according to the state of the art, e.g. cards as presently in practical use, such as the card of FR—A—1 542 878, the distance between the cylindrical surfaces is set before the start-up to be larger than the working distance under normal operating conditions, so as to allow for normal deformations, i.e. the bulging of the cylinders under the influence of the centrifugal force and the temperature effect. Thus the distance between the cooperating cylinders is too large during the whole start-up phase, and correspondingly during the run-down phase, so that the working conditions between the cylinders are unfavourable. This causes either imperfect transfer of the fibre web from one cylinder to the other or insufficient carding action. A machine working during the start-up phase, and during the run-down phase, under unfavourable conditions produces a qualitatively inferior product. In extreme cases, i.e. if the fibre web transfer from one cylinder to the other is rendered unreliable, or even impossible, as a result of a working distance which is too large, operation of the machine may be endangered. As the working distance(s) are set before the machine is started up, one is tempted to choose larger distances than required, in order to safely avoid any danger of clothing contact or interference during operation. The result is that the machines quite often operate with working distances which are too large, i.e. under unfavourable setting conditions.

Attempts have been made to counter the problems described by limiting the cylinder deformations by design measures. This, however, results in complicated and weighty designs, which increase the construction costs

of the machine and can not solve the problems entirely.

The problems described above also apply in corresponding manner for all the other machines used in a staple fibre spinning plant, in which first and second cylindrical surfaces co-operate at small working distances, e.g. certain opening machines, such as garnets, roller carding engines, etc.

It thus is the object of the present invention, to eliminate the disadvantages of the known processing machines of the staple fibre spinning plant of the abovementioned type and to provide a method of controlling the working conditions between two cooperating cylindrical surfaces, which are equipped with respective point clothings, for processing or mutually transferring a fibre web so that optimum working conditions are ensured at all times, particularly during the start-up phase and the run-down phase of the machine operation. Furthermore, the apparatus for implementing the method should be simple and reliable in operation and should be economical to manufacture, and above all not cause any complication and price increase of the machine.

This object is satisfied, in accordance with the invention, in a method of the initially named kind, in that either the working distance between the first and second surfaces or at least one physical parameter (such as rotational speed or temperature) of at least one of said first and second surfaces which is correlated with a change in said working distance, is measured, either continuously or cyclically, to produce a measured value related to the working distance, and in that the position of one of said surfaces is adjusted during operation of the machine in response to the measured value to maintain the working distance at a predetermined value.

The invention thus makes it possible to hold the working distance substantially constant, or to adjust the working distance during machine operation so that the machine always operates under ideal conditions with a corresponding improvement in the quality of the product.

An advantageous apparatus for carrying out the method of the invention is characterised by means for measuring, either continuously or cyclically, either said working distance, or a physical parameter correlated with the radius of at least one of the first and second cylindrical surfaces, to produce a measured value related to the working distance, and by means for adjusting the length and/or position of the support members for one of said first and second cylindrical surfaces, relative to support members for the other of said cylindrical surfaces, in response to said measured value to hold said working distance at the predetermined value.

The method and apparatus of the invention are advantageously applied to a card (which can

be designed as a roller card or as a revolving flat card).

Advantageous embodiments of the method and apparatus for carrying out the same are set forth in the subclaims.

The invention will now be described in more detail by way of example only and with reference to the drawings which show:

Fig. 1 a simplified, schematic side view of a carding apparatus,

Figs. 2a to 2c details of alternative adjustment devices for use in an apparatus according to Fig. 1,

Fig. 3 a simplified, schematic side view of an alternative embodiment,

Fig. 4 a schematic view of a further carding apparatus.

Referring firstly to Fig. 1 there can be seen a stationary frame 1 of a processing machine of a staple fibre spinning plant. The frame 1 consists of four vertical support elements 2 (only two of which are shown), two horizontal longitudinal side members 3 (only one of which is shown) and cross members (not shown) interconnecting the longitudinal side members 3 and the support elements 2 to make the support frame rigid. Two rotating cylinders comprising a main drum 4 and a doffer drum 5, each of which is equipped with a point clothing, are supported on the rigid support frame and co-operate at a small working distance *a*. The cylinder 4 is rotatably but non-displaceably supported for rotation about its axis 8 in two support members 7 (only one of which is shown), which are rigidly secured to the longitudinal side members 3 by bolts 6, and is rotated in the direction of the arrow *f*.

The cylinder 4 supports a point clothing 9 on its cylindrical surface and the clothing 9 plucks fibres from a fibre layer 12 presented by a rotating feeder roll 10 and a feeder plate 11 in such a way that a thin, more or less coherent fibre web (not shown) is formed on the surface of the cylinder 4. The point clothing 9 indicated in Fig. 1 is shown as a so-called flexible clothing consisting of steel wire points bent in knee-form. Any type of point clothing however, such as a rigid clothing consisting of a profiled wire with points, or a saw-tooth clothing, can be used.

The cooperating doffer cylinder 5 is rotatably supported about its axis 14 in two support members 13 (only one of which is shown) on the longitudinal side members 3 of the frame 1. The support members 13 are not however secured rigidly to the longitudinal side members 3 but are instead guided by two collared setbolts 15 in such a manner that they can be moved at right angles to the axis 14 over a small distance of the order of 1 to 2 mm. For this purpose slot openings 16 which permit longitudinal movement of the support members 13 while ensuring precise lateral guidance are provided in the fixing extensions 18 of the support members 13. The collars 17 of the collared setbolts 15 are somewhat higher than

the fixing extensions 18 of the support members 13 so that the setbolts 15 do not clamp the support members 13.

Clearly parallel movement of the support members 13 allows the working distance between the cylindrical surfaces of the cylinders 4 and 5 to be varied.

The cylinder 5 is also provided with a point clothing at its cylindrical surface and, in the illustrated embodiment, this point clothing is also a flexible steel wire clothing.

Good working conditions between the cylinders can be ensured only if the working distance a is maintained within precise and very close tolerances. This applies irrespective of whether the fibre web is transferred from one cylinder to the other or is simply processed (carding action).

The optimum value for the working distance a in the illustrated arrangement lies in the range $0.05 \text{ mm} < a < 0.3 \text{ mm}$ for cylinder diameters in the range from 0.20 to 1.5 m and for cylinder lengths of up to 2 m. The lower limit for the distance a is merely a value which is respected to avoid the danger of mutual contact or interference of the points of the clothings of the two cylinders. If this is not respected there is a danger of fire and of mechanical damage to the point clothings which are expensive.

The increase of the diameter of the cylinders, in particular the main drum 4, due to an increase in temperature of the cylinder is, as established by studies, of the order of about 0.08 mm per 10°C temperature increase and this corresponds to the order of magnitude of the optimum value of the distance a . Similar deformations are caused by the influence of centrifugal force.

In Fig. 1 the diameter of the cylinder 4 in its non-deformed state (i.e. prior to start-up of the machine and at room temperature) is designated D whereas $D + \Delta D$ designates the diameter (indicated in dash dotted lines) of the cylinder in its deformed state under the influence of centrifugal force and/or temperature effects.

On the assumption that the cylinder 5 does not suffer any deformation, an assumption which in many cases is a good approximation, an increase ΔD of the diameter of the main drum 4 will result in a reduction in the working distance a between the cylindrical surface and a non-deformed state of

$$\frac{\Delta D}{2}$$

thus, had the distance a been set to the ideal value while the cylinder 4 is in its undeformed state, the distance

$$a - \frac{\Delta D}{2}$$

existing when the cylinder 4 is in its deformed state would be below the permissible limit which would be very dangerous. This danger is prevented in the Fig. 1 embodiment by arranging for the two support members 13 for the cylinder 5 to be movable away from the fixed support 7 for the cylinder 4 by the corresponding distance

$$\frac{\Delta D}{2}$$

with this movement being effected in a plane which is substantially parallel to the plane containing the axes 8 and 14. For this purpose the machine frame 1 is provided with a fixed stop 20 on each of its side members 3, with the fixed stops 20 locating elements 21 which are used to change the position of the support members 13. Control adjustment of the elements 21 is effected by control means 22 via the control circuit 23.

The control means 22 receive a signal V via a circuit 24 from a suitable measuring element 25, working cyclically or continuously, which measures a physical parameter directly related to the dimensions of at least one of the two cylinders. In the embodiment of Fig. 1 e.g. the measuring element 25 is an instrument measuring the rotational speed of the shaft 8 of the cylinder 4 and the signal V is proportional to this speed. The control means 22 are preprogrammed accordingly to correlate the signal V with the dimensions of the cylinder 4, i.e. its diameter, to determine the corresponding cylinder diameter $D + \Delta D$ and to transmit a control signal S for adjustment of the elements 21 whereby to correct the distance between the axes 8 and 14 of the cylinders an amount

$$\frac{D}{2}$$

so that the working distance a is maintained constant at its predetermined value. If the dimensional change of the cylinder 4 occurs gradually, e.g. due to centrifugal force during the acceleration of the cylinder, the corresponding correction of the distance between the axes 8 and 14 by the elements 21 also takes place gradually so that the distance a is maintained constant over the whole start-up phase. The apparatus illustrated in Fig. 1 thus makes it possible to eliminate completely the effects of centrifugal force on the working conditions between the two cylinders 4 and 5.

In the apparatus according to Fig. 1 it is not essential to measure the rotational speed of the cylinder 4. It is also possible to measure the distance a between the cylindrical surfaces directly. The diameter of the cylinder 4 could be measured directly by an appropriate measuring instrument (e.g. by a contact-free feeler gauge,

or by a photo-optical measuring instrument—not shown). In this case the control signal S is directly proportional to the measured parameter. Measuring the rotational speed of the cylinder, however, proves to be simpler and more precise than direct measurement of the relatively small changes caused by the centrifugal force in the distance a, or of the diameter of the cylinder.

In analogue manner the distance between the axes 8 and 14 of the cylinders 4 and 5 can be varied to maintain the predetermined value for the working distance a, if the increase in diameter is caused by an increase in temperature rather than by centrifugal force. In this case a measuring element is used which either measures the diameter of the cylinder 4 directly, or a parameter directly connected with the diameter of the cylinder (such as the surface temperature of the cylinder 4), and which transmits a corresponding measuring signal V to the control means 22. The whole control arrangement, however, functions exactly in the same manner as in the case described before. The working distance a is again maintained at a predetermined value in spite of an increase in temperature of the cylinder 4.

Apparatuses also can be considered, which scan and correct for the effects of both centrifugal force and temperature on the working distance a, in which case the control means can be pre-programmed according to the relationship between the cylinder diameter and the rotational speed of the cylinder, and according to the relationship between the surface temperature of the cylinder and its diameter.

Furthermore it can prove advantageous to control the movement of the support members 13 using a displacement measuring instrument 26, which transmits a feed-back signal R to the control means 22 via the circuit 27. Using a control arrangement of this type the function of the moving elements 21 can be kept under control constantly, to eliminate any danger of contact between the clothings of the cylinders 4 and 5.

The function of the control means and the control circuits incorporating the measuring element 25, control means 22, moving elements 21 and, if desired, displacement measuring instruments 26, as shown and mentioned in this context, are well known in control technology and thus are not described in more detail herein.

In Figs. 2a through 2c several alternative designs are shown for the elements used to move the support members.

In Fig. 2a the element 21 takes the form of a threaded spindle 29 driven by a motor 28. The threaded spindle 29 in this arrangement is rotatably supported, but axially located, at one end in the fixed support 7 for the shaft 8 of the cylinder 4, whereas its other end, which is provided with a thread 30, is screwed into the movable support member 13 for the shaft 14 of

the cylinder 5. The distance between the axes 8 and 14 can be increased, or be reduced, by rotating the threaded spindle 29 in one direction and the opposite direction respectively.

An alternative design for the elements 21 is shown in Fig. 2b, where, thermal expansion of a metal rod is utilised to move the support 13. For this purpose a metal rod 31 is rigidly anchored, e.g. using threaded connections, in the support members 7 and 13. The heat supply required to thermally expand the metal rod 31 in the example of Fig. 2b is generated by an electrical resistor 32 directly wrapped around the rod 31. The electric current supply to the resistor is controlled by the control means 22 (Fig. 2). The rod 31 is surrounded by a protective cover 33, which has folds or undulations 34 making it axially expandable so that it can effortlessly follow the length variations of the rod 31. A further alternative design feature is also shown in Fig. 2b, namely, the use of prismatic guides 35 for the movable mounting of the support 13 on the side member 3.

A further alternative design for the elements 21 is shown in Fig. 2c. In this case the elements are constructed as in Fig. 2b but heated using a fluid. For this purpose the protective cover 33 is connected to a fluid supply duct 36 and to a fluid exit duct 37, which ducts merge into a fluid recipient 38. A pump 39 is inserted in the fluid supply duct 36 to pump fluid from the recipient 38 under pressure into the chamber 40 formed about the metal rod 31 by the protective cover.

The fluid in the recipient 38 is heated by a heating device 41 (e.g. an electrical resistance heating device) to a certain temperature determined by the control means 22 (Fig. 1), in such a way that the rod 31 expands to a greater or lesser degree to correct the working distance by adjusting the distance between the axes 8 and 14. For the fluid one can use a liquid (such as water or oil) or a gas (e.g. air). A system with circulation of heated air has proved particularly suitable.

The adjustment means shown in Fig. 2c are particularly suitable where a plurality of support elements (as described with reference to the design examples shown in Figs. 3 and 4) are to be controlled from common control means.

Fig. 3 shows an alternative embodiment which differs from the one shown in Fig. 1 in that the cylindrical surfaces carrying the point clothings are substantially coaxially arranged. In this arrangement only one of the cylindrical surfaces is present as a cylindrical surface of a rotating cylinder 47 and the other is formed by a recirculating flat card which is guided in a semi-circular arc adjacent the cylinder 47. Such arrangements are used mainly in processing the fibre web in a carding action.

The problem concerning the working distance between the two cooperating cylindrical surfaces, as described above, also exists with the arrangement of Fig. 3. The only difference

lies in the fact that the working distance is not changed by changing the distance between the rotational axes of the two cylinders, but e.g. is changed by changing the radius of at least one of the cylindrical surfaces as will be explained in detail in the following.

In Fig. 3 the machine frame 42 consists of two longitudinal side members 43 (one only being shown), four support elements 44 (two only being shown) and connecting cross-members (not shown). A support member 45 is rigidly mounted on each longitudinal side member 43. These support members 45 support the axis 46 of a rotatably supported cylinder 47 which is rotatable about the axis 46 in the direction of the arrow g and carries a point clothing 48.

The support 45 supports at its upper end a segment 50 which is rigidly connected with the support member via an intermediate member 49. A number of elements 51, 51a and 51b, which also act as support elements, are arranged as radial spokes on the segment 50. The elements 51, 51a and 51b are designed e.g. as the elements described with reference to Figs. 2a through 2c.

The support elements 51a and 51b each support respective bodies 54, and 55 which slide in respective radial guides 52 and 53. Axles 56 and 57 respectively, of flat chain deflecting rolls 58 and 59 are rotatably supported in respective ones of the bodies 54, 55. The radial positions of the deflecting rolls 58 and 59 can be changed with respect to the surface of the cylinder 47 by longitudinal expansion of the respective elements 51a, 51b. A so-called flat chain 60, consisting of a row of flat rods 62 circulates around the rolls 58 and 59. The flat rods 62 are arranged mutually parallel across the machine and are provided with a point clothing 61. At their ends the rods are interconnected to form a chain.

In the zone between the two deflecting rolls 58 and 59 the flat chain 60 is guided on each side above the cylinder surface by a guide arc 63 in such a way that the working distance between the points of the clothing of the cylinder 47 and the ones of the flats is precisely maintained. For this purpose the guide arcs 63 are supported by three moving elements 51. One of the deflecting rolls 58 or 59 respectively, is set into rotation by means not shown so that the whole flat chain moves slowly, the leg of the flat chain facing the surface of the cylinder 47 being guided by the guide arc 63 so that it moves on a circular path about the center of the axis 46. The elements 51a and 51b for positioning the two deflecting rolls 58 and 59 and the moving elements 51 for supporting and positioning the guide arc 63 are connected via circuits 64ⁱ through 64^v with control means 65, which jointly control all elements 51, 51a and 51b. The control means 65 are connected via a circuit 67 with a temperature gauge 66, which measures the tem-

perature t of the surface of the cylinder 47, and are pre-programmed according to the correlation between the dimensions of the cylinder 47, e.g. its diameter, and the temperature of its surface.

The operational function of the apparatus of Fig. 3 is similar to that of the apparatus of Fig. 1. If, e.g. due to an increase in temperature, the diameter of the cylinder 47 increases, this change is detected by the temperature gauge 66 indirectly as a function of the temperature t of the cylinder surface. The signal transmitted via the circuit 67 to the control means 65 is processed there, using the pre-programmed relations, into a signal corresponding to the increase ΔD of the diameter. The elements 51, 51a and 51b are activated via the circuits 64ⁱ through 64^v to effect a corresponding correction of

$$\frac{\Delta D}{2},$$

during this process the elements 51a and 51b remove the two rolls 58 and 59 over this correction distance away from the surface of the cylinder 47, whereas the elements 51 generate the same effect for the run of the flat chain 60, which cooperates with the cylinder surface, by deforming the guide arcs 63 in the sense of an increase of their radii by an amount

$$\frac{\Delta D}{2}.$$

Thus the working conditions between the two cylindrical surfaces of the cylinder 47 and of the flat chain 60 remain unchanged.

Turning now to Fig. 4 there can be seen a schematic side view of a so-called roller card which utilises the present method and apparatus at various pairs of rolls or cylinders.

The card comprises a base frame 68, on which a taker-in roll or licker-in roll 70, a main cylinder 72, and a doffer cylinder 74 are rotatably supported in respective pairs of supports 69, 71 and 73 only one of each of which is shown in the drawing. The supports 71 for the main cylinder 72 are rigidly screwed to the base frame 68, whereas the supports 69 and 73 are slidably guided on the base frame 68. Elements 75 and 76 are placed in the manner described before with reference to Fig. 1 between the fixed supports 71 and the movable supports 69 and 73 on each side of the machine. Four radially arranged elements 77 through 80 are provided on the supports 71, in similar manner to the apparatus described with reference to Fig. 3. These elements 77 through 80 support and position the worker rolls 81 through 84. The rolls are each guided in a fixed arc 85 on each side of the card in radially arranged guide slots 86.

The fibre feed on this card is effected using a feed chute 87, which feeds a feed roll 88 with a coordinated feeder plate 89.

The fibre material is taken over in form of a fibre web by the taker-in or licker-in roll 70 at the nip between the feed roll 88 and the feeder plate 89, is transferred to the main cylinder 72, is carded between the main cylinder 72 and the rolls 81 through 84 and, at the other end of the card, is transferred to the doffer cylinder 74. The working conditions at the processing points, and at the transfer points respectively between the different pairs of cylinders/rolls are constantly maintained at their optimum values by maintaining the working distances between the pairs of cylinders using the elements 75 through 80.

In the apparatus shown in Fig. 4 account is taken of the effects of both rotational speed of the cylinders and of the temperature increases. For this purpose an instrument 90, which measures the rotational speed of the axis 91 of the main cylinder 72, and a temperature gauge 92, which scans the temperature of the surface of the cylinder 72, are provided. These elements are connected via corresponding circuits 93, 94 with the control means 95 for all elements 75 through 80. The control means 95 are pre-programmed in accordance with the relationship between the diameter of the main cylinder 72 and its rotational speed and in accordance with the relationship between the diameter and the temperature of the surface of the main cylinder. Both influences thus are taken into account by the control means 95.

The arrangement shown in Fig. 4 for the main cylinder 72 can also be applied to other cylinders of the card. Thus provision can be made for the doffer rolls 96, 97 to be movable with respect to the doffer cylinder 74 and adjusted by corresponding elements.

The arrangements described herein based on thermal expansion of metal rods have proven particularly advantageous due to the absence of any mechanically movable parts. Furthermore, retrofitting of such apparatus to existing machines is possible in most cases without undue expense or complication.

Claims

1. A method of controlling the working distance (a) between first and second cylindrical surfaces of a staple fibre treatment machine each of which is equipped with a point clothing (9, 19; 48) and at least one of which is a surface of a rotatable cylinder (4; 47; 72), with the first and second cylindrical surfaces co-operating to process and/or mutually transfer a fibre web (12), characterised in that either the working distance (a) between the first and second surface, or at least one physical parameter (such as rotational speed or temperature) of at least one of said first and second surfaces which is correlated with a change in

said working distance (a), is measured, either continuously or cyclically, to produce a measured value related to the working distance and in that the position of one of said surfaces is adjusted during operation of the machine in response to the measured value to maintain the working distance (a) at a predetermined value.

2. A method according to claim 1 and characterised in that the predetermined value is constant.

3. A method according to claim 1 in which both the first and second cylindrical surfaces are the surfaces of rotatable cylinders (4, 5; 72, 70; 72, 74; 72, 81; 72, 82; 72, 83; 72, 84) and characterised in that the working distance (a) is maintained at the predetermined value by adjusting the distance between the rotational axes (8, 14; Fig. 4) of the cylinders.

4. A method according to claim 1 and characterised in that the distance between the cylindrical surfaces is maintained at the predetermined value by adjusting the radius of at least one of the cylindrical surfaces (Fig. 3).

5. A method according to claim 1 and characterised in that the parameter measured is influenced by centrifugal force generated by the rotation of said cylinder (4, 47; 72).

6. A method according to claim 1 and characterised in that the parameter measured is influenced by a thermally generated dimensional change of said cylinder (4; 47; 72).

7. A method according to claim 1 and characterised in that the parameter measured is influenced by centrifugal force as well as by a thermally generated dimensional change of said cylinder (4; 47; 72).

8. A method according to claim 1 and characterised in that the distance between the first and second cylindrical surfaces is measured at the web processing or transfer point.

9. A method according to claim 1 and characterised in that the parameter measured is the diameter of said cylinder (4; 47; 72).

10. A method according to claim 1 and characterised in that the parameter measured is the temperature of said cylinder (4; 47; 72).

11. A method according to claim 1 and characterised in that the parameter measured is the rotational speed of said cylinder (4; 47; 72).

12. A method according to either of claims 5 and 11 and characterised in that the correlation is based on the relationship between the diameter of said cylinder (4; 47; 72) and the rotational speed of the cylinder (4; 47; 72).

13. A method according to either of claims 6 and 10 and characterised in that the correlation is based on the relationship between the diameter of said cylinder (4; 47; 72) and the surface temperature of the cylinder (4; 47; 72).

14. A method according to claim 1 and characterised in that the correlation is based on the relationship between the diameter of said cylinder (4; 47; 72) and the rotational speed of

the cylinder (4; 47; 72) as well as on the relationship between the diameter of said cylinder (4; 47; 72) and the surface temperature of the cylinder (4; 47; 72).

15. A method in accordance with claim 1 and characterised in that the predetermined value of the working distance ranges between 0.05 and 0.3 mm.

16. A method in accordance with any one of the preceding claims wherein the position of one of said surfaces is adjusted during operation either by a screw thread adjustment (21; 75; 76) or by thermal adjustment of the length and/or position of support means (31; 51, 51a, 51b; 75, 76, 77, 78, 79, 80) for the said surface.

17. Apparatus for carrying out the method of claim 1 characterised by means (25; 66; 90, 92) for measuring, either continuously or cyclically, either said working distance (a) or a physical parameter correlated with the radius of at least one of the first and second cylindrical surfaces to produce a measured value related to the working distance and by means (22, 28; 22, 32; 22, 33, 36, 37, 38, 39, 40, 41; 65, 64^I, 64^{II}, 64^{III}, 64^{IV}, 64^V; 95) for adjusting the length and/or position of the support members (21, 13; 51a, 51b, 54, 55; 69, 75; 73, 76; 77, 86; 78, 86; 79, 86; 80, 86) for one of said first and second cylindrical surfaces relative to support members (7; 45; 71) for the other of said cylindrical surfaces in response to said measured value to hold said working distance (a) at the predetermined value.

18. Apparatus in accordance with claim 17 and characterised in that the first and second cylindrical surfaces are substantially coaxial.

19. Apparatus in accordance with claim 17 and characterised in that the support members (13, 21; 69, 75; 73, 76; 77, 86; 78, 86; 79, 86; 80, 86) are movably arranged in a plane substantially parallel to a plane containing the axes of curvature of said first and second cylindrical surfaces.

20. Apparatus in accordance with any one of the preceding claims 17 to 19 and characterised in that the treatment machine is a card and in that both the first and second cylindrical surfaces are cylindrical surfaces of respective first and second rotating cylinders (4, 5; 72, 70; 72, 74; 72, 81; 72, 82; 72, 83; 72, 84) and in that said first and second rotating cylinders are either the main drum (4; 72) and the doffer cylinder (5; 74), or the main drum (72) and at least one rotating worker roll (81, 82, 83, 84) of a roller card.

21. Apparatus in accordance with either of claims 17 and 18 and characterised in that the first and second surfaces are a cylindrical surface of a main drum (72) and an inner arc (63) of the recirculating flat chain (60) of a recirculating flat card.

22. Apparatus according to any one of the preceding claims 17 to 21 and characterised in

that the measuring means is a feeler for the diameter of said cylinder (4; 47; 72).

23. Apparatus according to any one of the preceding claims 17 to 21 and characterised in that the measuring means is a temperature gauge (66; 90) for the temperature of the surface of said cylinder (47; 72).

24. Apparatus according to any one of the preceding claims 17 to 21 and characterised in that the measuring means is a measuring instrument (25, 92) for the rotational speed of said cylinder (4; 72).

25. Apparatus according to one of claims 22, 23 or 25 and characterised in that the measuring means (25; 66; 90, 92) operates contact-free.

26. Apparatus according to any one of the preceding claims and characterised in that said means (22, 28; 22, 32; 22, 33, 36, 37, 38, 39, 40, 41; 65, 64^I, 64^{II}, 64^{III}, 64^{IV}, 64^V; 95) for adjusting the length and/or position of the support members (21, 13; 51, 51a, 51b, 54, 55; 69, 75; 73, 76; 77, 86; 78, 86; 79, 86; 80, 86) includes control means (22, 65, 95) pre-programmed according to the direct correlation between the radius of at least one of the first and second cylindrical surfaces and the parameter measured.

27. Apparatus according to any one of the preceding claims 17 to 26 and characterised in that said means for adjusting the position of the support members (21, 13; 51, 51a, 51b, 54, 55; 69, 75; 73, 76; 77, 86, 78, 86; 79, 86; 80, 86) comprise distance changing mechanical connections (21, 29; 31; 51, 51a, 51b; 75; 76; 77; 78; 79; 80).

28. Apparatus according to claim 27 and characterised in that said mechanical connections comprise a driven threaded spindle (21).

29. Apparatus according to claim 27 and characterised in that said mechanical connections comprise a thermally expandable metal rod (31; 51a, 51b; 75; 76; 77; 78; 79; 80).

30. Apparatus according to claim 29 and characterised in that the metal rod (31) is surrounded by a protective cover (33), within which a fluid heatable by a heat supply device (36 through 41) is contained, the temperature of which fluid is controlled by the control means.

31. Apparatus according to claim 30 and characterised in that the heat supply device (36 through 41) is a system with warm air circulation.

32. Apparatus according to claim 29 and characterised by a heat supply device in the form of an electrical resistor (32) for heating the metal rod (31) directly.

33. Apparatus according to claim 27, characterised in that common control means (95) control a plurality of moving elements (75, 76, 77, 78, 79, 80).

Patentansprüche

1. Verfahren zum Steuern des Arbeitsabstandes (a) zwischen ersten und zweiten zylindrischen Flächen einer Stapelfaser-Verarbeitungsmaschine, welche jeweils mit einer Spitzengarnitur (9, 19; 48) ausgerüstet sind und von denen mindestens eine Zylinderfläche die Oberfläche eines drehbaren Zylinders (4; 47; 72) ist, wobei die erste und die zweite zylindrische Fläche zur Verarbeitung und/oder zur gegenseitigen Übertragung eines Faservlieses (12) zusammenwirken, dadurch gekennzeichnet, daß entweder der Arbeitsabstand (a) zwischen der ersten und der zweiten Fläche oder mindestens ein mit einer Änderung des Arbeitsabstandes (a) korrelierter physikalischer Parameter (z.B. Drehzahl oder Temperatur) entweder kontinuierlich oder zyklisch zur Erzeugung eines auf den Arbeitsabstand bezogenen Meßwertes gemessen wird und daß die Lage einer der Oberflächen während des Betriebs der Maschine in Abhängigkeit von dem Meßwert zur Einhaltung des Arbeitsabstandes (a) bei dem vorbestimmten Wert nachgestellt wird.

2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß der vorbestimmte Wert konstant ist.

3. Verfahren nach Anspruch 1, bei dem sowohl die erste als auch die zweite zylindrische Fläche die Oberflächen von drehbaren Zylindern (4, 5; 72, 70; 72, 74; 72, 81; 72, 82; 72, 83; 72, 84) sind, dadurch gekennzeichnet, daß der Arbeitsabstand (a) durch Nachstellen des Abstandes zwischen den Drehachsen (8, 14; Fig. 4) der Zylinder bei dem vorbestimmten Wert gehalten wird.

4. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß der Abstand zwischen den Zylinderflächen durch Nachstellen des Radius mindestens einer der zylindrischen Flächen bei dem vorbestimmten Wert gehalten wird (Fig. 3).

5. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß der gemessene Parameter durch die bei der Drehung des Zylinders (4; 47; 72) erzeugte Fliehkraft beeinflusst wird.

6. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß der gemessene Parameter durch eine thermisch bedingte Dimensionsänderung des Zylinders (4; 47; 72) beeinflusst wird.

7. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß der gemessene Parameter sowohl durch die Fliehkraft als auch durch eine thermisch bedingte Dimensionsänderung des Zylinders (4; 47; 72) beeinflusst wird.

8. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß der Abstand zwischen der ersten und der zweiten zylindrischen Fläche an der Vliesbearbeitungs- oder -übertragungsstelle gemessen wird.

9. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß der gemessene Para-

meter der Durchmesser des Zylinders (4; 47; 72) ist.

10. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß der gemessene Parameter die Temperatur des Zylinders (4; 47; 72) ist.

11. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß der gemessene Parameter die Drehzahl des Zylinders (4; 47; 72) ist.

12. Verfahren nach einem der Ansprüche 5 oder 11, dadurch gekennzeichnet, daß die Korrelation durch die Beziehung zwischen dem Durchmesser des Zylinders (4; 47; 72) und der Drehzahl des Zylinders (4; 47; 72) begründet ist.

13. Verfahren nach einem der Ansprüche 6 oder 10, dadurch gekennzeichnet, daß die Korrelation durch die Beziehung zwischen dem Durchmesser des Zylinders (4; 47; 72) und der Oberflächentemperatur des Zylinders (4; 47; 72) begründet ist.

14. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß die Korrelation sowohl durch die Beziehung zwischen dem Durchmesser des Zylinders (4; 47; 72) und der Drehzahl des Zylinders (4; 47; 72) als auch durch die Beziehung zwischen dem Durchmesser des Zylinders (4; 47; 72) und der Oberflächentemperatur des Zylinders (4; 47; 72) begründet ist.

15. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß der vorbestimmte Wert des Arbeitsabstandes zwischen 0,05 mm und 0,3 mm liegt.

16. Verfahren nach einem der vorangehenden Ansprüche, dadurch gekennzeichnet, daß die Lage einer der Flächen während des Betriebes entweder durch eine Spindelnachstellung (21; 75; 76) oder durch thermische Nachstellung der Länge und/oder der Stellung der Supporte (31; 51, 51a, 51b; 75, 76, 77, 78, 79, 80) für die Fläche nachgestellt wird.

17. Vorrichtung zur Durchführung des Verfahrens nach Anspruch 1, dadurch gekennzeichnet, daß entweder kontinuierlich oder zyklisch arbeitende Meßeinrichtungen (25; 66; 90, 92) für entweder den Arbeitsabstand (a) oder einen mit dem Radius mindestens einer der ersten oder zweiten zylindrischen Flächen korrelierten physikalischen Parameter zur Erzeugung eines auf den Arbeitsabstand bezogenen Meßwertes vorgesehen sind, und daß Einrichtungen (22, 28; 22, 32; 22, 33, 36, 37, 38, 39, 40, 41; 65, 64^I, 64^{II}, 64^{III}, 64^{IV}, 64^V; 95) zum Nachstellen der Länge und/oder der Lage der Supporte (21, 13; 51a, 51b, 54, 55; 69, 75; 73, 76; 77, 86; 78, 86; 79, 86; 80, 86) für eine der ersten oder zweiten zylindrischen Flächen gegenüber den Supporten (7; 45; 71) für die jeweils andere zylindrische Fläche in Abhängigkeit von dem Meßwert vorgesehen sind, um den Arbeitsabstand (a) bei dem vorbestimmten Wert zu halten.

18. Vorrichtung nach Anspruch 17, dadurch gekennzeichnet, daß die erste und die zweite

zylindrische Fläche im wesentlichen koaxiale Flächen sind.

19. Vorrichtung nach Anspruch 17, dadurch gekennzeichnet, daß die Supporte (13, 21; 69, 75; 73, 76; 77, 86; 78, 86; 79, 86; 80, 86) in einer im wesentlichen zur die Krümmungsachsen der ersten und der zweiten zylindrischen Fläche enthaltenden Ebene parallelen Ebene verschiebbar angeordnet sind.

20. Vorrichtung nach einem der Ansprüche 17 bis 19, dadurch gekennzeichnet, daß die Bearbeitungsmaschine eine Karde ist, daß sowohl die erste als auch die zweite zylindrische Fläche zylindrische Oberflächen von jeweiligen ersten bzw. zweiten rotierenden Zylindern (4, 5; 72, 70; 72, 74; 72, 81; 72, 82; 72, 83; 72, 84) sind und daß der erste und der zweite rotierende Zylinder entweder der Tambour (4; 72) und der Abnehmer (5; 74) oder der Tambour (72) und mindestens eine rotierende Arbeitswalze (81, 82, 83, 84) einer Walzenkarde sind.

21. Vorrichtung nach Anspruch 17 oder 18, dadurch gekennzeichnet, daß die erste und die zweite Oberfläche zylindrische Flächen eines Tambours (72) und der innere Bogen (63) der umlaufenden Deckelkette (60) einer Wanderdeckelkarde sind.

22. Vorrichtung nach einem der Ansprüche 17 bis 21, dadurch gekennzeichnet, daß die Meßeinrichtung ein Fühler für den Durchmesser des Zylinders (4; 47; 72) ist.

23. Vorrichtung nach einem der Ansprüche 17 bis 21, dadurch gekennzeichnet, daß die Meßeinrichtung ein Temperaturfühler (66; 90) für die Oberflächentemperatur des Zylinders (47; 72) ist.

24. Vorrichtung nach einem der Ansprüche 17 bis 21, dadurch gekennzeichnet, daß die Meßeinrichtung ein Drehzahlmesser (25, 92) für die Drehzahl des Zylinders (4; 72) ist.

25. Vorrichtung nach einem der Ansprüche 22, 23 oder 25, dadurch gekennzeichnet, daß die Meßeinrichtung (25; 66; 90, 92) berührungsfrei arbeitet.

26. Vorrichtung nach einem der Ansprüche 17 bis 25, dadurch gekennzeichnet, daß die Längen- und/oder Lagenverstelleinrichtung (22, 28; 22, 32; 22, 33, 36, 37, 38, 39, 40, 41; 65, 64^I, 64^{II}, 64^{III}, 64^{IV}, 64^V; 95) für die Supporte (21, 13; 51, 51a, 51b, 54, 55; 69, 75; 73, 76; 77, 86; 78, 86; 79, 86; 80, 86) entsprechend der direkten Korrelation zwischen dem Radius mindestens einer der ersten oder der zweiten zylindrischen Flächen mit dem gemessenen Parameter vorprogrammierte Steuereinrichtungen (22, 65, 95) enthält.

27. Vorrichtung nach einem der Ansprüche 17 bis 26, dadurch gekennzeichnet, daß die Nachstelleinrichtungen für die Lage der Supporte (21, 13; 51, 51a, 51b, 54, 55; 69, 75; 73, 76; 77, 86; 78, 86; 79, 86; 80, 86) abstandsändernde mechanische Verbindungen (21, 29; 31; 51, 51a, 51b; 75; 76; 77; 78; 79; 80) enthält.

28. Vorrichtung nach Anspruch 27, dadurch

gekennzeichnet, daß die mechanische Verbindung eine angetriebene Gewindespindel (21) ist.

29. Vorrichtung nach Anspruch 27, dadurch gekennzeichnet, daß die mechanische Verbindung einen thermisch dehnbaren Metallstab (31; 51a, 51b; 75; 76; 77; 78; 79; 80) enthält.

30. Vorrichtung nach Anspruch 29, dadurch gekennzeichnet, daß der Metallstab (31) von einer Schutzhülle (33) umgeben ist, in welchem ein durch ein Wärmezufuhrgerät (36—41) aufheizbares Fluid enthalten ist, dessen Temperatur durch die Steuereinrichtungen gesteuert wird.

31. Vorrichtung nach Anspruch 30, dadurch gekennzeichnet, daß das Wärmezufuhrgerät (36—41) ein System mit Warmluftzirkulation ist.

32. Vorrichtung nach Anspruch 29, gekennzeichnet durch ein Wärmezufuhrgerät in Form eines direkt den Metallstab (31) aufheizenden elektrischen Widerstandes (32).

33. Vorrichtung nach Anspruch 27, dadurch gekennzeichnet, daß gemeinsame Steuereinrichtungen (95) eine Vielzahl von Verschiebeelementen (75, 76, 77, 78, 79, 80) steuern.

Revendications

1. Procédé pour contrôler la distance de travail (a) entre des première et seconde surfaces cylindriques d'une machine de traitement de fibres coupées, dont chacune est équipée d'une garniture de pointes (9, 19; 48) et dont au moins l'une est une surface d'un cylindre rotatif (4; 47; 72), les première et seconde surfaces cylindriques coopérant pour traiter et/ou se transférer mutuellement un voile de fibres (12), caractérisé par le fait que la distance de travail (a) entre les première et seconde surfaces, ou au moins l'un des paramètres physiques (tel que la vitesse de rotation ou la température) d'au moins l'une desdites première et seconde surfaces qui est en corrélation avec une variation de ladite distance de travail (a) est mesuré, soit continûment, soit par intervalles, pour produire une valeur mesurée qui se rapporte à la distance de travail, et par le fait que la position de l'une desdites surfaces est ajustée lors du fonctionnement de la machine en fonction de la valeur mesurée afin de maintenir la distance de travail (a) à une valeur prédéterminée.

2. Procédé selon la revendication 1 et caractérisé par le fait que la valeur prédéterminée est constante.

3. Procédé selon la revendication 1 dans lequel les première et seconde surfaces cylindriques sont toutes deux les surfaces de cylindres rotatifs (4, 5; 72, 70; 72, 74; 72, 81; 72, 82; 72, 83; 72, 84) et caractérisé par le fait que la distance de travail (a) est maintenue à la valeur prédéterminée en ajustant la distance entre les axes de rotation (8, 14; figure 4) des cylindres.

4. Procédé selon la revendication 1 et caractérisé par le fait que la distance entre les surfaces cylindriques est maintenue à la valeur prédéterminée en ajustant le rayon d'au moins l'une des surfaces cylindriques (figure 3).

5. Procédé selon la revendication 1, et caractérisé par le fait que le paramètre mesuré est influencé par la force centrifuge engendrée par la rotation dudit cylindre (4; 47; 72).

6. Procédé selon la revendication 1 et caractérisé par le fait que le paramètre mesuré est influencé par une variation de dimension dudit cylindre (4; 47; 72) provoquée thermiquement.

7. Procédé selon la revendication 1 et caractérisé par le fait que le paramètre mesuré est influencé aussi bien par la force centrifuge que par une variation de dimension, provoquée thermiquement dudit cylindre (4; 47; 72).

8. Procédé selon la revendication 1 et caractérisé par le fait que la distance entre les première et seconde surfaces cylindriques est mesurée au point de traitement ou de transfert du voile.

9. Procédé selon la revendication 1 et caractérisé par le fait que le paramètre mesuré est le diamètre dudit cylindre (4; 47; 72).

10. Procédé selon la revendication 1 et caractérisé par le fait que le paramètre mesuré est la température dudit cylindre (4; 47; 72).

11. Procédé selon la revendication 1 et caractérisé par le fait que le paramètre mesuré est la vitesse de rotation dudit cylindre (4; 47; 72).

12. Procédé selon l'une des revendications 5 et 11 et caractérisé par le fait que la corrélation est fondée sur le rapport entre le diamètre dudit cylindre (4; 47; 72) et la vitesse de rotation du cylindre (4; 47; 72).

13. Procédé selon l'une des revendications 6 et 10 et caractérisé par le fait que la corrélation est fondée sur le rapport entre le diamètre dudit cylindre (4; 47; 72) et la température superficielle du cylindre (4; 47; 72).

14. Procédé selon la revendication 1 et caractérisé par le fait que la corrélation est fondée sur le rapport entre le diamètre dudit cylindre (4; 47; 72) et la vitesse de rotation du cylindre (4; 47; 72), ainsi que sur le rapport entre le diamètre dudit cylindre (4; 47; 72) et la température superficielle du cylindre (4; 47; 72).

15. Procédé selon la revendication 1 et caractérisé par le fait que la valeur prédéterminée de la distance de travail est comprise entre 0,05 et 0,3 mm.

16. Procédé selon l'une quelconque des revendications précédentes, dans lequel la position de l'une desdites surfaces est ajustée en fonctionnement, soit par un ajustement fileté (21; 75; 76), soit par un ajustement thermique de la longueur et/ou de la position de moyens de support (31; 51, 51a, 51b; 75, 76, 77, 78, 79, 80) pour ladite surface.

17. Appareil pour la mise en oeuvre du procédé de la revendication 1, caractérisé par

des moyens (25; 66; 90, 92) pour mesurer, soit continûment, soit par intervalles, ou bien ladite distance de travail (a), ou bien un paramètre physique en corrélation avec le rayon d'au moins l'une des première et seconde surfaces cylindriques pour produire une valeur mesurée se rapportant à la distance de travail, et par des moyens (22, 28; 22, 32; 22, 33, 36, 37, 38, 39, 40, 41; 65, 64^I, 64^{II}, 64^{III}, 64^{IV}, 64^V; 95) pour ajuster la longueur et/ou la position des éléments de support (21, 13; 51a, 51b, 54, 55; 69, 75; 73, 76; 77, 86; 78, 86; 79, 86; 80, 86) pour l'une desdites première et seconde surfaces cylindriques par rapport à des éléments de support (7; 45; 71) pour l'autre desdites surfaces cylindriques en fonction de ladite valeur mesurée, afin de maintenir ladite distance de travail (a) à la valeur prédéterminée.

18. Appareil selon la revendication 17 et caractérisé par le fait que les première et seconde surfaces cylindriques sont sensiblement coaxiales.

19. Appareil selon la revendication 17 et caractérisé par le fait que les éléments de support (13, 21; 69, 75; 73, 76; 77, 86; 78, 86; 79, 86; 80, 86) sont agencés de façon mobile dans un plan sensiblement parallèle à un plan contenant les axes de courbure desdites première et seconde surfaces cylindriques.

20. Appareil selon l'une quelconque des revendications précédentes 17 à 19 et caractérisé par le fait que la machine de traitement est une cardeuse, et par le fait que les première et seconde surfaces cylindriques sont toutes deux des surfaces cylindriques de premier et second cylindres rotatifs respectifs (4, 5; 72, 70; 72, 74; 72, 81; 72, 82; 72, 83; 72, 84) et par le fait que lesdits premier et second cylindres rotatifs sont soit le tambour principal (4; 72) et le cylindre peigneur (5; 74), soit le tambour principal (72) et au moins l'un des cylindres rotatifs de travail (81, 82, 83, 84) d'une cardeuse à hérissons.

21. Appareil selon l'une des revendications 17 et 18 et caractérisé par le fait que les première et seconde surfaces sont une surface cylindrique d'un tambour principal (72) et un arc interne (63) de la chaîne aplatée sans fin (60) d'une cardeuse sans fin à chapeaux.

22. Appareil selon l'une quelconque des revendications précédentes 17 à 21 et caractérisé par le fait que le moyen de mesure est un détecteur pour le diamètre dudit cylindre (4; 47; 72).

23. Appareil selon l'une quelconque des revendications précédentes 17 à 21 et caractérisé par le fait que le moyen de mesure est une sonde thermométrique (66; 90) pour la température de la surface dudit cylindre (47; 72).

24. Appareil selon l'une quelconque des revendications précédentes 17 à 21 et caractérisé par le fait que le moyen de mesure est un

instrument de mesure (25, 92) pour la vitesse de rotation dudit cylindre (4; 72).

25. Appareil selon l'une des revendications 22, 23 ou 25 et caractérisé par le fait que le moyen de mesure (25; 66; 90, 92) agit sans contact.

26. Appareil selon l'une quelconque des revendications précédentes et caractérisé par le fait que lesdits moyens (22, 28; 22, 32; 22, 33, 36, 37, 38, 39, 40, 41; 65, 64', 64'', 64''', 64^{IV}, 64^V; 95) pour ajuster la longueur et/ou la position des éléments de support (21, 13; 51, 51a, 51b, 54, 55; 69, 75; 73, 76; 77, 86; 78, 86; 79, 86; 80, 86) comportent des moyens de commande (22, 65, 95) programmés à l'avance en fonction de la corrélation directe entre le rayon d'au moins l'une des première et seconde surfaces cylindriques et le paramètre mesuré.

27. Appareil selon l'une quelconque des revendications précédentes 17 à 26 et caractérisé par le fait que lesdits moyens pour ajuster la position des éléments de support (21, 13; 51, 51a, 51b, 54, 55; 69, 75; 73, 76; 77, 86, 78, 86; 79, 86; 80, 86) comportent des liaisons mécaniques (21, 29; 31; 51, 51a, 51b; 75; 76; 77; 78; 79; 80) de variation de distance.

28. Appareil selon la revendication 27 et caractérisé par le fait que lesdites liaisons

mécaniques comportent une broche fileté entraînée (21).

29. Appareil selon la revendication 27 et caractérisé par le fait que lesdites liaisons mécaniques consistent en une tige métallique dilatable thermiquement (31; 51a, 51b; 75; 76; 77; 78; 79; 80).

30. Appareil selon la revendication 29 et caractérisé par le fait que la tige métallique (31) est entourée par un couvercle protecteur (33) à l'intérieur duquel est renfermé un fluide pouvant être chauffé par un dispositif (36 à 41) fournissant de la chaleur, la température dudit fluide étant contrôlée par les moyens de commande.

31. Appareil selon la revendication 30 et caractérisé par le fait que le dispositif (36 à 41) fournissant de la chaleur est un système à circulation d'air chaud.

32. Appareil selon la revendication 29 et caractérisé par un dispositif fournissant de la chaleur réalisé sous la forme d'une résistance électrique (32) pour chauffer directement la tige métallique (31).

33. Appareil selon la revendication 27, caractérisé par le fait que des moyens communs de commande (95) commandent plusieurs éléments mobiles (75, 76, 77, 78, 79, 80).

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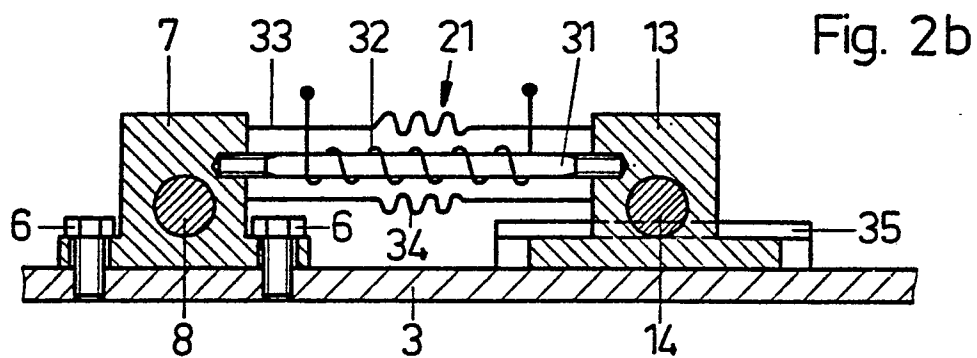
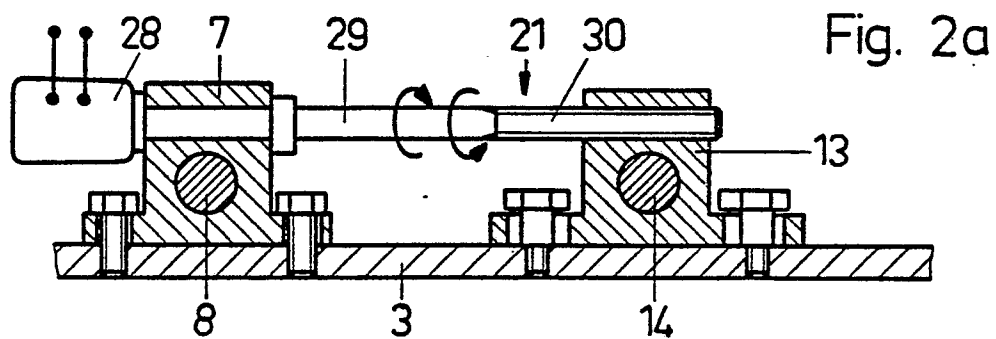
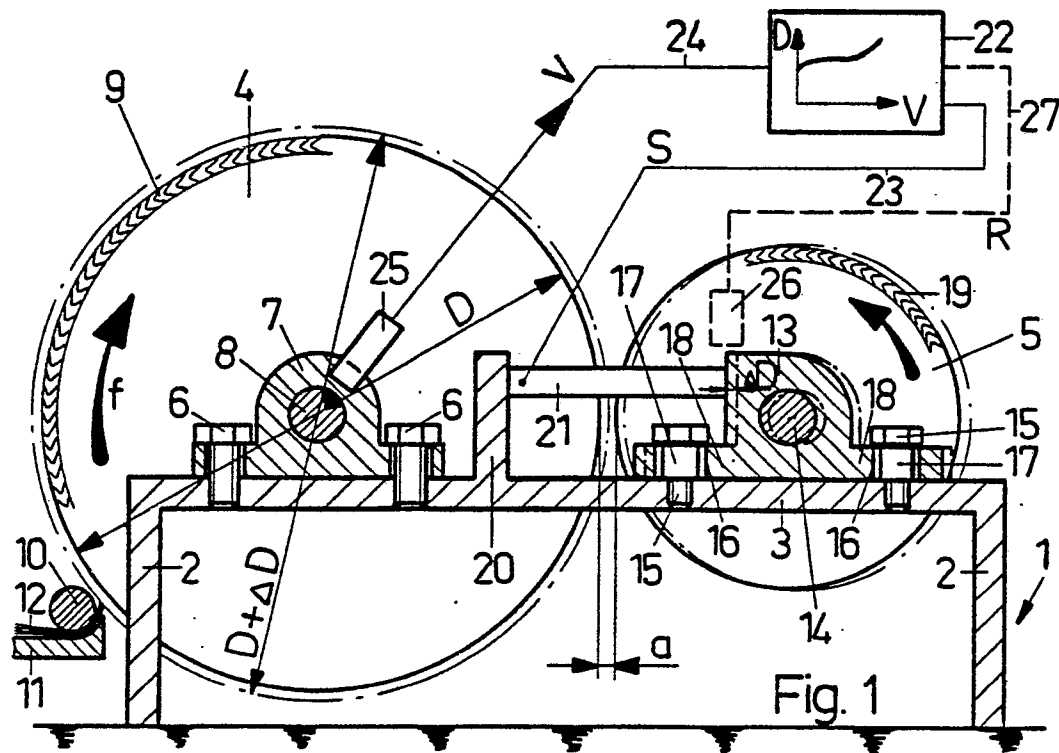


Fig. 2c

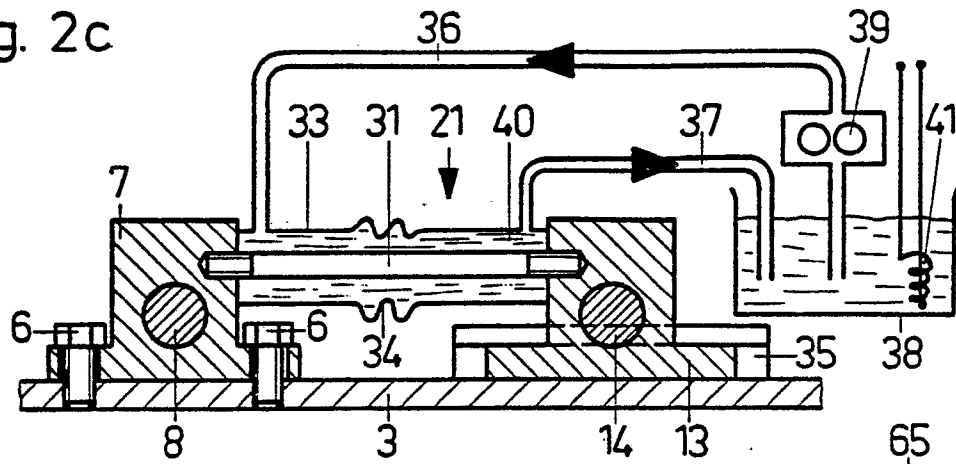
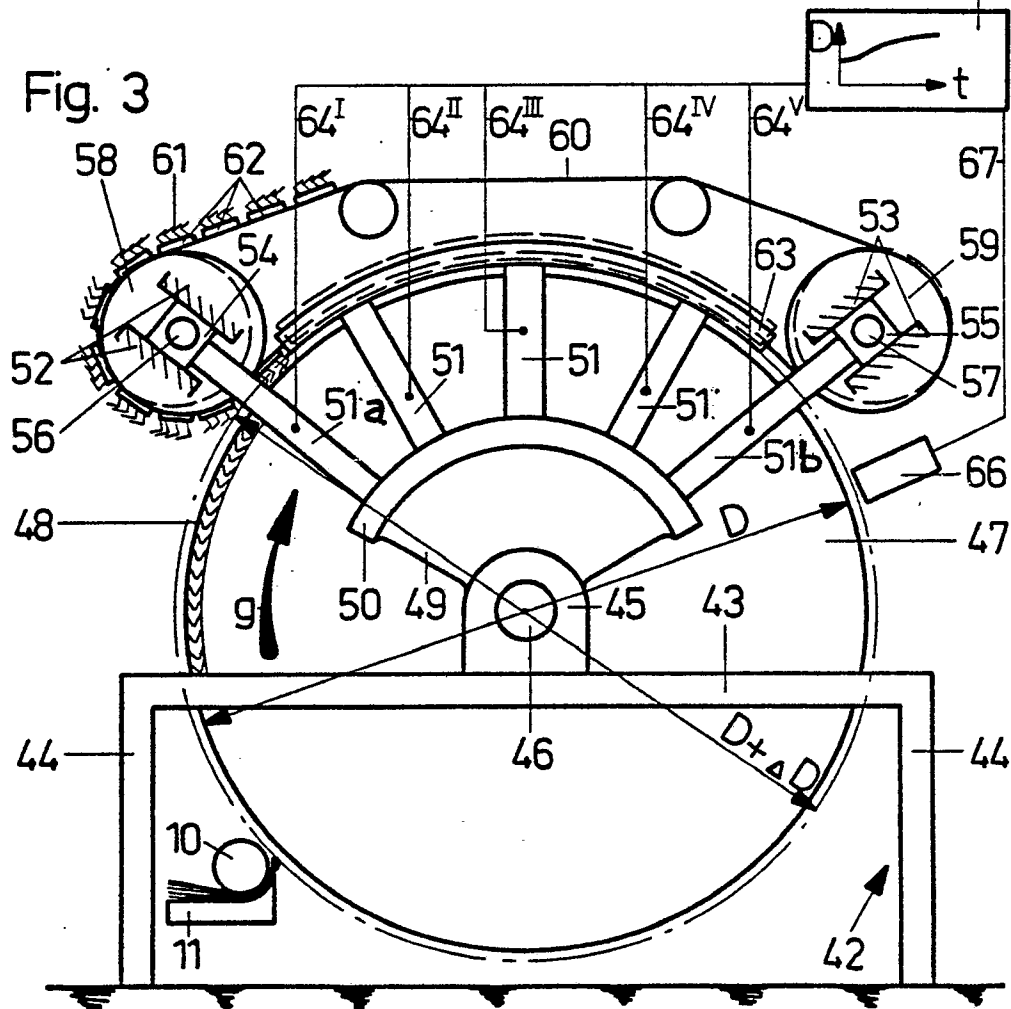


Fig. 3



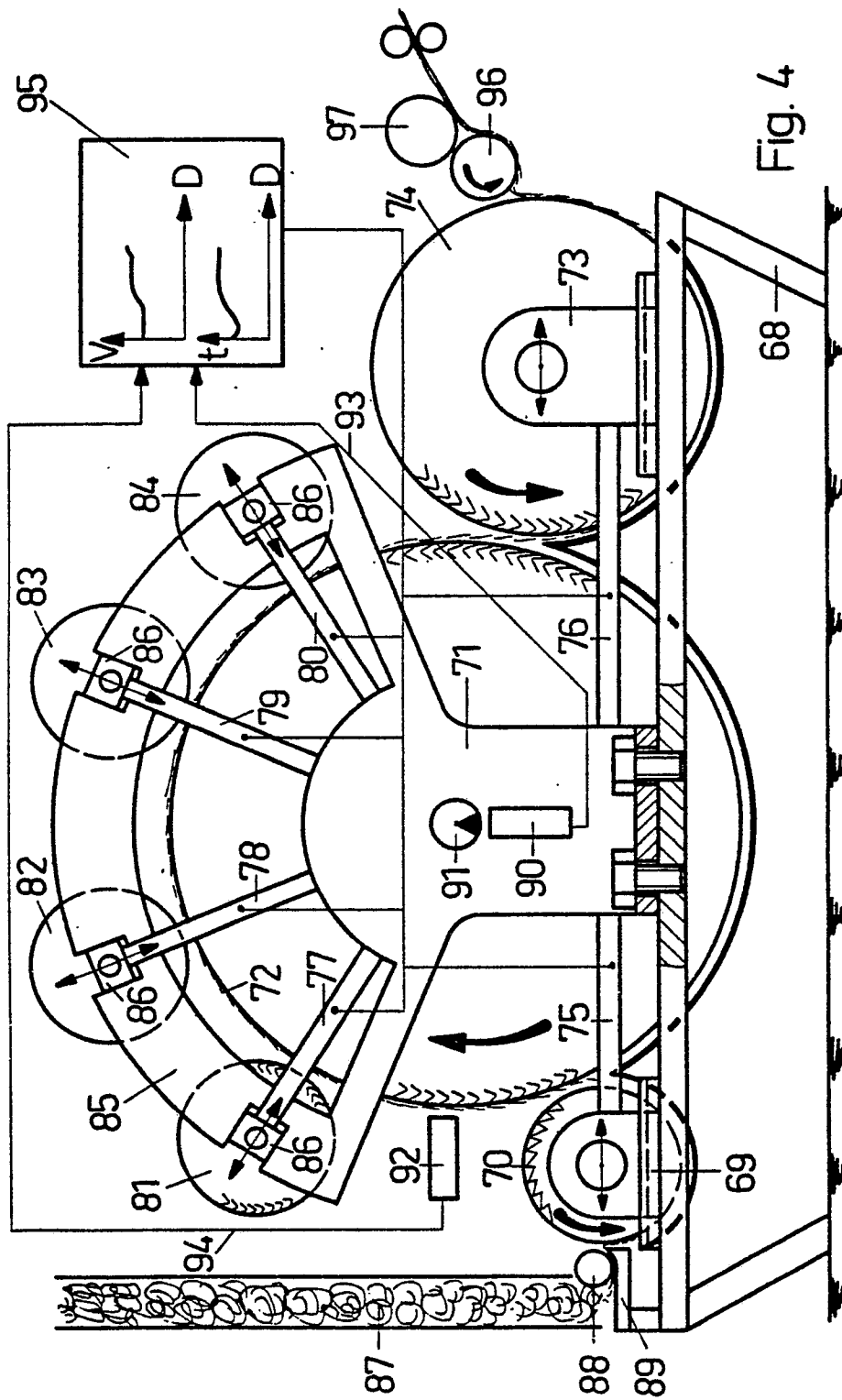


Fig. 4